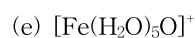
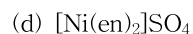
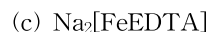
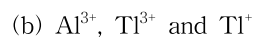


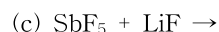
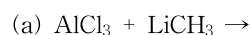
1. Name the following coordination compounds. (2 points each)



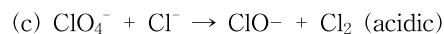
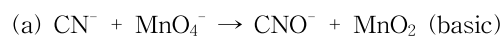
2. Rank the following Lewis acids from hardest to softest and explain your reasoning: (2 points each)



3. Complete the following reactions: (2 points each)



4. Balance following redox equations: (2 points each)

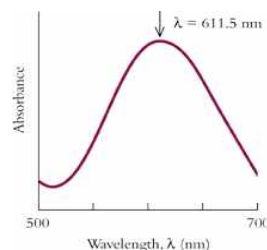


5. For each of the following, determine the charge on the complex ion, the oxidation state of the metal, and the coordination number of the metal: (3 points each)



6. Blue copper proteins are blue when they contain Cu^{2+} but colorless as Cu^+ compounds. The color comes from an interaction in which a photon causes an electron to transfer from a sulfur lone pair on a cysteine ligand to the copper center. Why does this charge transfer interaction occur for Cu^{2+} but not Cu^+ ? (5 points)

7. A portion of the absorption spectrum of a complex ion, $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]^+$, is represented by the following graph: (2 points each)



Relationships among Wavelength & Color		
Wavelength(nm)	Color Absorbed	Complementary Color
>720	Infrared	Colorless
720	Red	Green
680	Red-orange	Blue-green
610	Orange	Blue
580	Yellow	Indigo
560	Yellow-green	Violet
530	Green	Purple
500	Blue-green	Red
480	Blue	Orange
430	Indigo	Yellow
410	Violet	Lemon-yellow
<400	Ultraviolet	Colorless

(a) Estimate the crystal field splitting energy (in kilojoules per mole).

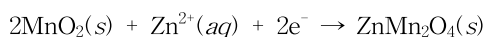
(b) What color is the complex?

(c) Name the complex cation.

(d) Draw all possible isomers of the complex.

(e) Draw the crystal field energy level diagram and show the electron transition that gives the complex its color.

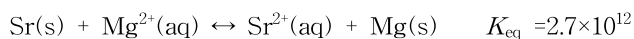
8. The first battery to find widespread commercial use was the carbon-zinc dry cell, in which the cathode reaction is:



In a flashlight, one of these batteries provides 0.0048

A. If the battery contains 4.0 g of MnO_2 and fails after 90 % of its MnO_2 is consumed, calculate the operating life of the flashlight. (5 points)

9. For the reaction between strontium and magnesium,



Calculate E° for a strontium-magnesium battery (5 points)

10. An electroplating apparatus is used to coat jewelry with gold. What mass of gold can be deposited from a solution that contains $\text{Au}(\text{CN})_4^-$ ions if a current of 5.0 A flows for 30.0 min? (10 points)

11. Seawater is approximately 0.5 M each in Na^+ and Cl^- ions. By evaporation, NaCl ($K_{\text{sp}} = 6.2$) can be precipitated from this solution. If 1.00×10^2 L of seawater is evaporated, at what volume will the first solid NaCl appear? (5 points)

12. Phosphate ions are a major pollutant of water supplies.

They can be removed by precipitation using solutions of Ca^{2+} ions because the K_{sp} of calcium phosphate is 2.0×10^{-33} . Suppose that 3.00×10^3 L of wastewater containing PO_4^{3-} at 2.2×10^{-3} M is treated by adding 120 moles of solid CaCl_2 (which dissolves completely). (4 points each)

- (a) What is the concentration of phosphate ions after treatment?

- (b) What mass of calcium phosphate precipitates?

13. Thionyl chloride (SOCl_2) is used to remove water of hydration from metal halide hydrates. Besides the anhydrous metal halide, the products are SO_2 and HCl . (4 points each)

- (a) Draw the Lewis structure of SOCl_2 .

- (b) Balance the reaction of iron(III) chloride hexahydrate with SOCl_2

14. Suppose you titrate 0.300 L of a 0.200 M solution of sodium formate with 6.0 M HCl . (K_{a} for formic acid is 1.8×10^{-4}). (4 points each)

- (a) What is the pH of the solution before beginning the titration?

- (b) What is the pH of the solution halfway through the titration?

- (c) What is the pH at the stoichiometric point?